INTERFACE & DESIGN REFERENCE KIT

For Use with eMagin Rev2 SVGA+, SVGA 3D, and OLED-XL OLED Microdisplays

USER'S MANUAL

DRAFT III

For part numbers:

Monocular Interface & Design Reference Kit	EMA-200002
Binocular Interface & Design Reference Kit	EMA-200003

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1. INTRODUCTION

The Interface & Design Reference Kit, compatible with both SVGA+ and SVGA 3D Series Microdisplays, provides the user with a highly compact, portable way of operating an eMagin OLED Microdisplay with a variety of video inputs. This product was designed to deliver a complete tool for developers to evaluate and integrate eMagin microdisplays into new products. The Interface & Design Reference Kit is compatible both with analog RGB and composite (NTSC, SMPTE-170, PAL) sources. The included software package and cables provides access to the microdisplay's on-board register settings from any Windows-based PC through a serial port. When used with an SVGA 3D OLED Microdisplay, the binocular Interface & Design Reference Kit features automatic stereovision signal to allow the user easy development of stereoscopic 3D applications.

2. FEATURES

- PC Analog Monitor Video Interface (VESA Display Monitor Timing Standard compliant)
- Composite interface cable for connection to SMPTE-170, NTSC, PAL sources
- RS-232 (serial) cable allows access to microdisplay registers
- Supporting Software (Windows)
- ON/OFF power switch
- Push-button brightness control
- Push-button image scan direction control
- VGA monitor cable
- USB Power Cable, length 2 feet (NOTE: Provided cable is compatible with USB 1.0 and 2.0 USB ports, but may not be compatible with all types of PCs. In some cases an external 5V DC power supply may be necessary)
- Regulated AC/DC adapter (optional)
- Auto detection of stereovision input signal for SVGA 3D OLED Microdisplays (binocular configuration only)
- Compatibility with eMagin SVGA+ and SVGA 3D Microdisplays

2.1. Standard Built-in Software

- The presence of frame sequential stereovision input is automatically detected and set up when the display is turned on. Switching the power off and then on will initiate detection of stereovision signals on binocular kits, if the incoming signal is changed during operation.
- Automatic determination of incoming frame rate and matching
- Image orientation adjustment with single button push makes integration into various systems easier.
- Luminance can be stepped in 255 of the luminance range steps with momentary pushing of the up/down luminance button. If the luminance control button is held down in the up or down position for more than 1 second, rapid scanning through the luminance range will initiate up or down to permit fast changing of display luminance.
- Comes ready with a high brightness mode accessible through a special button sequence.

2.2. Software Features

- Read/write capabilities allow adjustments of microdisplay register settings to fine-tune image characteristics
- Software slide bar control over the cathode voltage (Vcommon) input in 255 equal steps
- Software slide bar control over the microdisplay's brightness in 255 equal steps
- Download and install new firmware files into your Interface & Design Reference Kit for easy upgrades and expanded functionality

- Ability to read the ambient temperature measured at the microdisplay's location
- Save feature stores custom register settings for convenience

2.3. Features Comparison Tables

TABLE 2-1: FUNCTIONALITY COMPARISION BETWEEN SVGA+ AND SVGA 3D MICRODISPLAYS

Capability	SVGA+	SVGA 3D
Ability to interface display with a PC	Yes	Yes
Access to microdisplay registers (with included software and serial cable)	Yes	Yes
Button-activated brightness control on unit	Yes	Yes
Button-activated rotation control on unit	Yes	Yes
Display SVGA (800 x 600) image at 60Hz	Yes	Yes
Display SVGA (800 x 600) Stereovision 3D image (binocular)*	No	Yes
Display NTSC, PAL, or RS-170 image	Yes	No

3. SYSTEM REQUIREMENTS & SPECIFICATIONS

3.1. System Requirements

- For analog RGB inputs: A PC capable of producing a VGA or SVGA signal
- For composite inputs: An NTSC, PAL, or SMPTE-170 video source
- Support software requires a Windows PC with an RS-232 serial port

3.2. Stereovision 3D Requirements

- Binocular Interface & Design Reference Kit
- A video graphics adapter capable of supporting a Stereovision 3D video signal. Additional drivers may need to be downloaded from the manufacturer's website.
- Two SVGA 3D OLED Color Microdisplays (EMA-100052). Stereovision is not compatible with SVGA+ OLED Microdisplays

3.3. PC Interface Kit Parameters

- Power — Monocular = 300 to 500 mW
Binocular = 600 to 850 mW
(Depending on brightness setting and images)
- Weight — 4.0 oz (interface module & cable)

3.4. Mechanical Dimensions & Features (Dimensions in Inches)

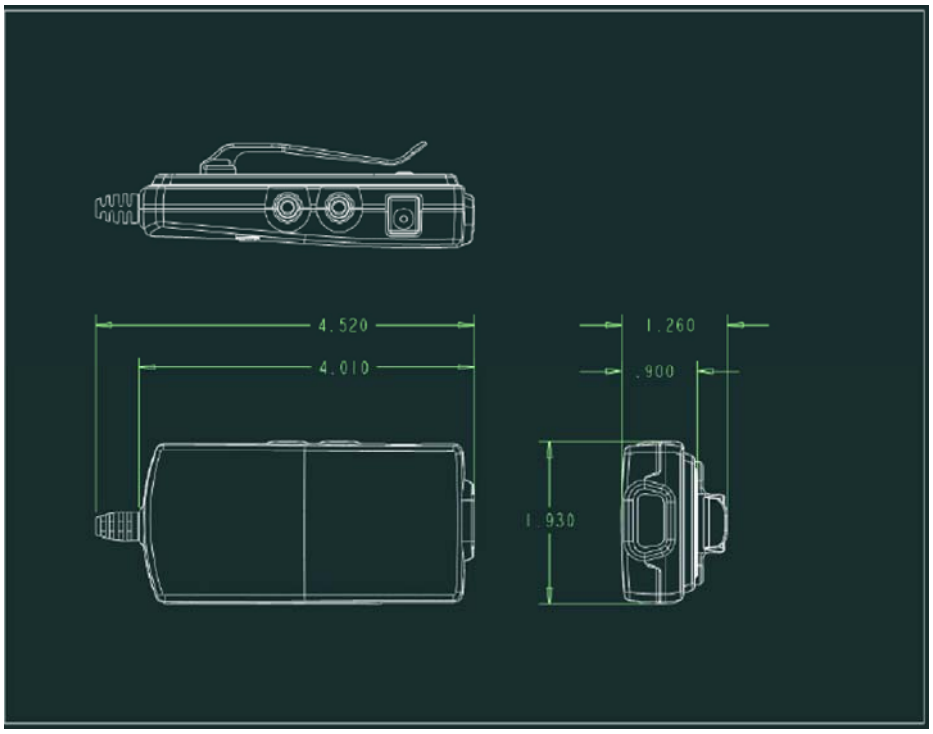

Figure 3-1 Interface & Design Reference Kit Dimensions (inches)

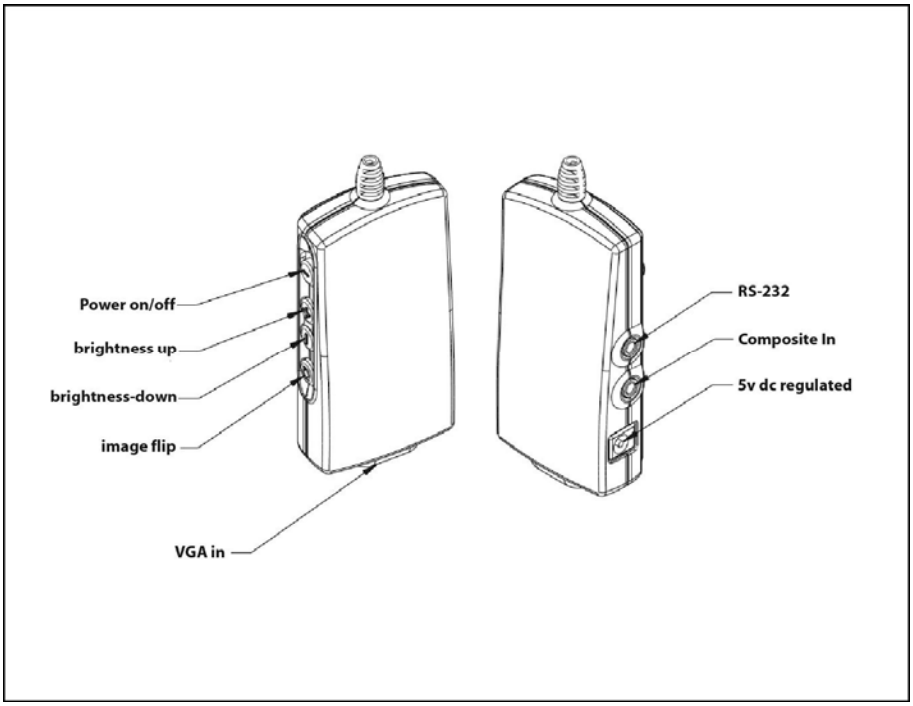

Figure 3-2 Interface & Design Reference Kit Features Layout

4. INTERFACE & DESIGN REFERENCE KIT COMPONENTS

4.1. Monocular Interface & Design Reference Kit

Part Number	Item Description
EMA-200002	Monocular Interface & Design Reference Kit
EMA-100153	Monocular OLED Cable Assembly
A01-500004-01	OLED Display Interface Module
591-02111-01	VGA Cable, 1 foot
591-03014-01	USB to Power Input Cable, 2 foot
A01-500205-00	RS232-to-I2C Cable
C01-500317-00	Composite Input Cable

5. INTERFACE CONNECTIONS & SETUP

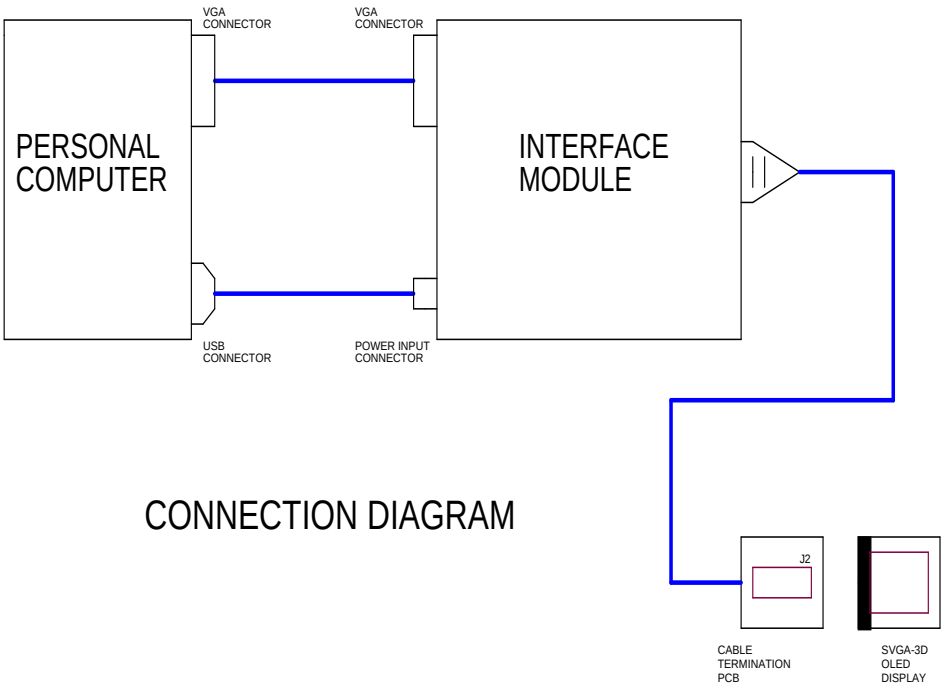

Figure 5-1 Interface Connection Diagram

5.1. Connect Display to Cable Assembly

The microdisplay connects to the Cable Termination Board via a 30-pin board-to-board connector. The present version of the connector is **NOT** keyed so it is important to correctly orient the display. Refer to the picture below for the proper orientation. The display is seen face up above the Cable Termination board and is in correct positioning for connection.

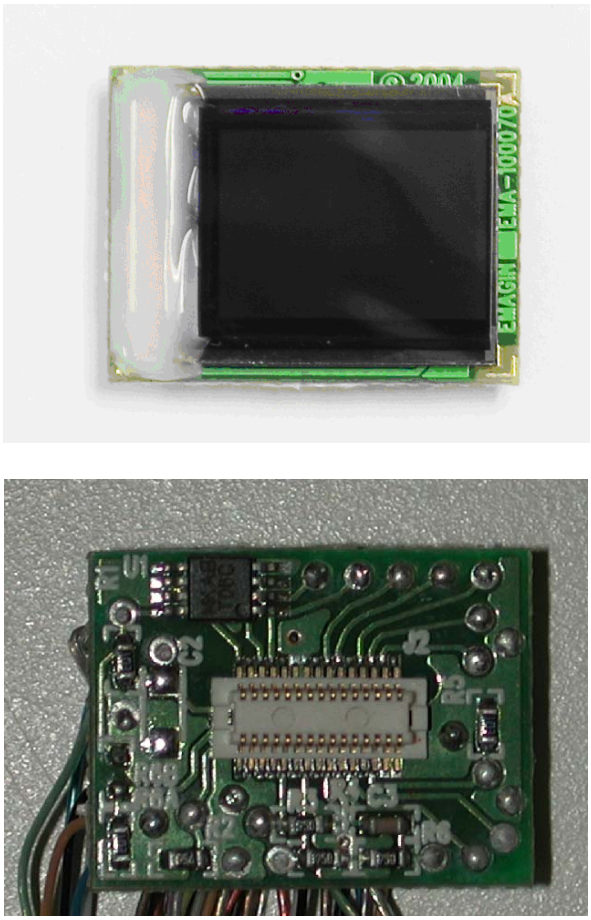

Figure 5-2 Connection Orientation Illustration

Lift the display by its sides and take care not to press on the active area or leave fingerprint marks on it. Position the display board such that the connectors match and the "J2" is in a normally readable orientation. Insert the display into the Cable board.

5.2. Setup PC for Proper Video Output

- The default compatible resolution is SVGA (800x600) with a refresh rate of 60 Hz. If you are using this input set the video resolution for 800x600 in your PC's display properties.
- Ensure that the refresh rate to set to 60 Hz, or other supported refresh rate per the display specification.
- If you are using a laptop PC, you may need to export the video signal to an external monitor. This is usually accomplished through a keypress including the Fn key + a designated function key. See your PC's operation instructions for more information.
- If applicable, enable Stereovision 3D on your PC's video graphics adapter.

5.3. Power Up

- Slide the power switch to the ON position (slide away from the other switches).

Note: Power supplies with voltage spikes can damage the display. If using any input other than the USB to power connection supplied with the system or the optional regulated AC/DC adapter, use caution to make sure the power is from a low noise voltage source. Use only 5V DC supplies with no more than a maximum +/-0.25V variation.

5.4. Power Down

- Slide the power switch to the OFF position (slide toward the other switches).

5.5. High Brightness Mode

Each Interface & Design Reference Kit is preinstalled with the capability to drive a display in high bias mode. In order to access the high bias ranges you need to activate this mode by simultaneously pressing the image orientation button and the brightness down button (shown with a minus (-) sign).

eMagin strongly recommends that you drive the microdisplay at the minimum luminance necessary for your application. This will extend the lifetime of the display to its maximum possible lifetime. As OLED microdisplays are emissive devices, driving the microdisplay at high bias levels will decrease its overall lifetime.

6. USING THE INTERFACE & DESIGN REFERENCE KIT SOFTWARE

The Interface & Design Reference Kit includes a support software suite with the following functionality.

- Perform software microdisplay brightness adjustments through 255 equal steps
- Perform software adjustments of the Vcommon input to the microdisplay through 255 equal steps
- Read the ambient temperature at the microdisplay site
- Perform reads and writes to the Interface & Design Reference Kit EEPROM
- Download and install new versions of the Interface & Design Reference Kit to update or provide new functionality using an RS-232 connection
- Read/write register values to the microdisplay to control various characteristics (see your microdisplay's User Specification for more information)

6.1. Serial Interface Command Set

The Interface & Design Reference Kit can be controlled by sending commands and data using the included RS-232 cable. The software package includes a file called **`DRK_SW.exe`** developed for this purpose.

Using the eMagin Interface & Design Reference Kit Software

1. Connect the serial cable to the PC (Port 1) and to the RS232 connector on the Interface & Reference Design Kit
2. Connect the power cable to the Interface & Reference Design Kit
3. Connect the video source to the Interface & Reference Design Kit
4. Turn on the Interface & Reference Design Kit
5. Start the **`DRK_SW.exe`** application and a screen should appear like that shown below:

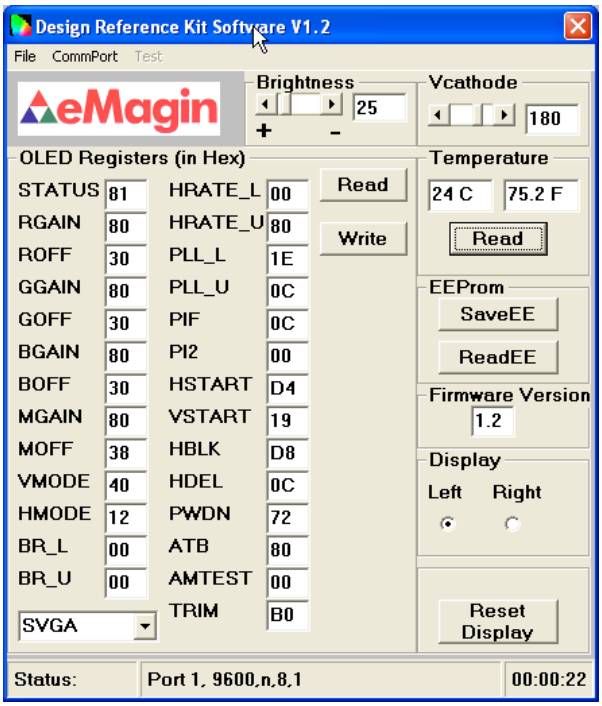

Figure 6-1 Interface & Design Reference Kit Software Utility

6. The application communicates with the PIC on the Interface & Design Reference Kit and reads the initial status of the "Brightness," "Vcathode," and "OLED Registers" outputs.
7. The read/write buttons shown in the "OLED Registers" panel will read/write the register settings in their corresponding boxes from/to the OLED microdisplay.
8. The read/write buttons displayed in the EEProm panel will read/write the settings displayed in the register boxes from/to the Interface & Design Reference Kit's EEProm. This will allow you to save custom settings you wish to upload to the microdisplay when its power is cycled.

Direct control of the Interface & Design Reference Kit can also be implemented into a customer specific application using the following hardware protocol and command set.

6.1.1. Hardware Protocol

- bit, no parity
- 9600 baud
- No hardware handshake

6.1.2. eMagin Software Command Set

TABLE 6-1 COMMAND SET LIST FOR ADDRESSING THE MICRODISPLAY REGISTERS

Command	Description
C	Adjust the COMMON (Cathode) voltage Usage: CX where X = 0 to 255
R	Read all 27 Microdisplay Registers. Usage: R Returns 27 register values
G	Send a register address Usage: GX where X = 0 to 27
D	Send a data value to the Interface & Design Reference Kit Usage: DX where X = 0 to 255
W	Write a register Usage: W Note: The W command is preceded by a GX DY command
T	Read the temperature sensor value Usage: T Returns a value
U	Adjust the microdisplay brightness Usage: UX where X = 0 to 255
S	Returns the Brightness and COMMON (Cathode) level values Usage: S Returns two values, brightness first then COMMON
V	Returns the firmware version number. Usage: V Returns a value

Note: The commands and values are typically generated from a control program. The values are sent in binary format to the Interface & Design Reference Kit microcontroller, which will process these natively in binary. Below is an example write instance using the provided software:

In order to write the decimal value 81 to register 3, the following commands need to be issued: G3D81W No space is required between the commands

Figure 6-2 Example microdisplay register value write using included software

6.2. Using Hyperterminal With the Interface & Design Reference Kit

If you will use Hyperterminal to control the Interface & Design Reference Kit please note that Hyperterminal converts all input data to ASCII characters. Therefore, the X value mentioned in the table above needs first to be converted to its ASCII equivalent in order to be recognized by the Interface & Design Reference Kit firmware. Received information will also be displayed as ASCII code. An ASCII to decimal (or hexadecimal) conversion must be performed to read the correct values sent via the serial interface. We have provided an example write instance and ASCII character table for your reference.

To write the decimal value 81 to register 3, the following commands need to be issued:
G CTRL-C D Q W

Ctrl+C (pressing the Ctrl and C key simultaneously) is the ASCII equivalent of decimal 3

Note: No space is required between the commands. The spacing above is for clarity only.

Figure 6-3 Example microdisplay register value write using Hyperterminal

6.2.1. ASCII Table of Commands

TABLE 6-2 TABLE OF ASCII CHARACTER CODES

Non-Printing Characters					Printing Characters								
Name	**Ctrl char**	**Dec**	**Hex**	**Char**	**Dec**	**Hex**	**Char**	**Dec**	**Hex**	**Char**	**Dec**	**Hex**	**Char**
null	ctrl-@	0	00	NUL	32	20	Space	64	40	@	96	60	`
start of heading	ctrl-A	1	01	SOH	33	21	!	65	41	A	97	61	a
start of text	ctrl-B	2	02	STX	34	22	"	66	42	B	98	62	b
end of text	ctrl-C	3	03	ETX	35	23	#	67	43	C	99	63	c
end of xmit	ctrl-D	4	04	EOT	36	24	$	68	44	D	100	64	d
enquiry	ctrl-E	5	05	ENQ	37	25	%	69	45	E	101	65	e
acknowledge	ctrl-F	6	06	ACK	38	26	&	70	46	F	102	66	f
bell	ctrl-G	7	07	BEL	39	27	'	71	47	G	103	67	g
backspace	ctrl-H	8	08	BS	40	28	(	72	48	H	104	68	h
horizontal tab	ctrl-I	9	09	HT	41	29	)	73	49	I	105	69	i
line feed	ctrl-J	10	0A	LF	42	2A	*	74	4A	J	106	6A	j
vertical tab	ctrl-K	11	0B	VT	43	2B	+	75	4B	K	107	6B	k
form feed	ctrl-L	12	0C	FF	44	2C	,	76	4C	L	108	6C	l
carriage feed	ctrl-M	13	0D	CR	45	2D	-	77	4D	M	109	6D	m
shift out	ctrl-N	14	0E	SO	46	2E	.	78	4E	N	110	6E	n
shift in	ctrl-O	15	0F	SI	47	2F	/	79	4F	O	111	6F	o
data line escape	ctrl-P	16	10	DLE	48	30	0	80	50	P	112	70	p
device control 1	ctrl-Q	17	11	DC1	49	31	1	81	51	Q	113	71	q
device control 2	ctrl-R	18	12	DC2	50	32	2	82	52	R	114	72	r
device control 3	ctrl-S	19	13	DC3	51	33	3	83	53	S	115	73	s
device control 4	ctrl-T	20	14	DC4	52	34	4	84	54	T	116	74	t
neg acknowledge	ctrl-U	21	15	NAK	53	35	5	85	55	U	117	75	u
synchronous idel	ctrl-V	22	16	SYN	54	36	6	86	56	V	118	76	v
end of xmit block	ctrl-W	23	17	ETB	55	37	7	87	57	W	119	77	w
cancel	ctrl-X	24	18	CAN	56	38	8	88	58	X	120	78	x
end of medium	ctrl-Y	25	19	EM	57	39	9	89	59	Y	121	79	y
substitute	ctrl-Z	26	1A	SUB	58	3A	:	90	5A	Z	122	7A	z
escape	ctrl-[	27	1B	ESC	59	3B	;	91	5B	[	123	7B	{
file separator	ctrl-\	28	1C	FS	60	3C	<	92	5C	\	124	7C	|
group separator	ctrl-]	29	1D	GS	61	3D	=	93	5D	]	125	7D	}
record separator	ctrl-^	30	1E	RS	62	3E	>	94	5E	^	126	7E	~
unit separator	ctrl-_	31	1F	US	63	3F	?	95	5F	_	127	7F	DEL

6.3. Downloading New Firmware Versions to the Interface & Design Reference Kit

The ability to download new versions of the firmware ensures that you will have the latest functionality without having to send your Interface & Design Reference Kit for reprogramming. A utility that downloads and installs new firmware versions is included in the software package.

6.3.1. Using the Firmware Download Utility

Firmware files can be downloaded as hex files. Before attempting to download and install new firmware versions make sure that you have received a firmware hex file from an eMagin source.

To load your firmware files, follow the following steps:

1. Connect the serial cable to the PC and to the RS232 connector on the Interface & Design Reference Kit.
2. Connect the power cable to the Interface & Design Reference Kit.
3. Connect your video source to the Interface & Design Reference Kit.
4. Start the `PICdownloader.exe` application included in your software package. A window should appear like that below:

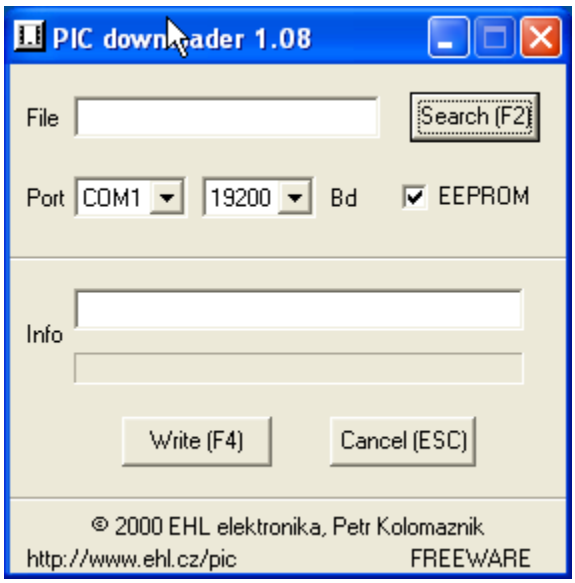

Figure 6-4 Firmware download utility

5. Make sure the following settings are shown
   a. Port = COM1
   b. Baud = 19200
   c. EEPROM box should be checked
6. Click the Search button to find the hex file you wish to install. **Note: The power on the Interface & Design Reference should be off while setting up your download. Only turn on the power to the Interface & Design Reference Kit when you are ready to write your new firmware to the PIC.**
7. Once successfully found, click the write button.
8. When you turn on the Interface & Design Reference Kit the hex file should begin to upload. The progress bar will turn blue.
9. When the upload is complete, the Interface & Design Reference Kit will run.

7. ADVANCED USER INFORMATION

7.1. Microcontroller

The Interface & Design Reference Kit circuit board utilizes a Microchip PIC16F876 microcontroller. This is a CMOS Flash microcontroller in a 28 pin package. Provisions are on the circuit board for in circuit reprogramming but are not accessible without opening the case. When using the internal programming connector VCC to the microcontroller is isolated from the rest of the board by removing the jumper between pins 1 and 2 of J3. Please refer to the Microchip PIC16F87X datasheet available from Microchip Technology Inc. for additional information about the microcontroller and programming.

The main function of the microcontroller is to communicate with the OLED display and the digital pot that controls the brightness of the display. The microcontroller also monitors the 3D Flipflop to determine whether or not a Stereovision 3D signal is present. All communication is over the internal I^2C bus and the microcontroller acts as the bus master. On power up the registers of the OLED are initialized with the default settings programmed into the microcontroller. After initialization the microcontroller scans the pushbuttons for user input and monitors the 3D Flipflop. The microcontroller enters the 3D mode only if a 3D signal is present and a second OLED is detected.

If one of the Brightness pushbuttons is pushed the microcontroller transmits a new numeric value to the digital pot to change the brightness voltage. This new value is then stored in non-volatile memory so this value will be used on the next power-up.

7.2. I^2C bus

The microcontroller is the bus master and communication occurs at the standard 100KHz clock rate. The microcontroller, the OLED and the digital pot all operate from 3.3VDC so the I^2C bus must also operate using 3.3V logic levels. The maximum speed allowed for I^2C bus communication is 400KHz. The digital pot is a Analog Devices AD5243-10 and answers to I^2C bus address 5Eh. Please refer to the Philips I^2C bus specification available on the Philips website for detailed information.

8. REVISION HISTORY

Revision Level	Date	Description